San Joaquin River Salt and Boron TMDL Progress Update

28 August 2001

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Workshop Agenda

- Welcome and Introductions
- Overview of Regional Board's TMDL Development Process and Timelines
- Background and Problem Statement
- Source Analysis
- Loading Capacity
- Load Allocations
- Salt and Boron TMDL Basin Plan Amendment Process

Overview of Regional Board's TMDL Development Process and Timelines

What Is a TMDL and Why Do One?

- TMDL = Total Maximum Daily Load
- TMDLs are required under section 303(d) of the Federal Clean Water Act
  - TMDLs must be developed for pollutants and waterbodies that have been identified on 303(d) list of impaired waterbodies

What Is a TMDL?

- A total maximum daily load (TMDL) is the amount of a specific pollutant that a waterbody can receive and still maintain a water quality standard
- TMDLs allocate pollutant loads to point and nonpoint sources…

What Is a TMDL?

- TMDL = WLA + LA + MOS + background

  WLA: waste load allocation for point sources
  LA: load allocations for nonpoint sources
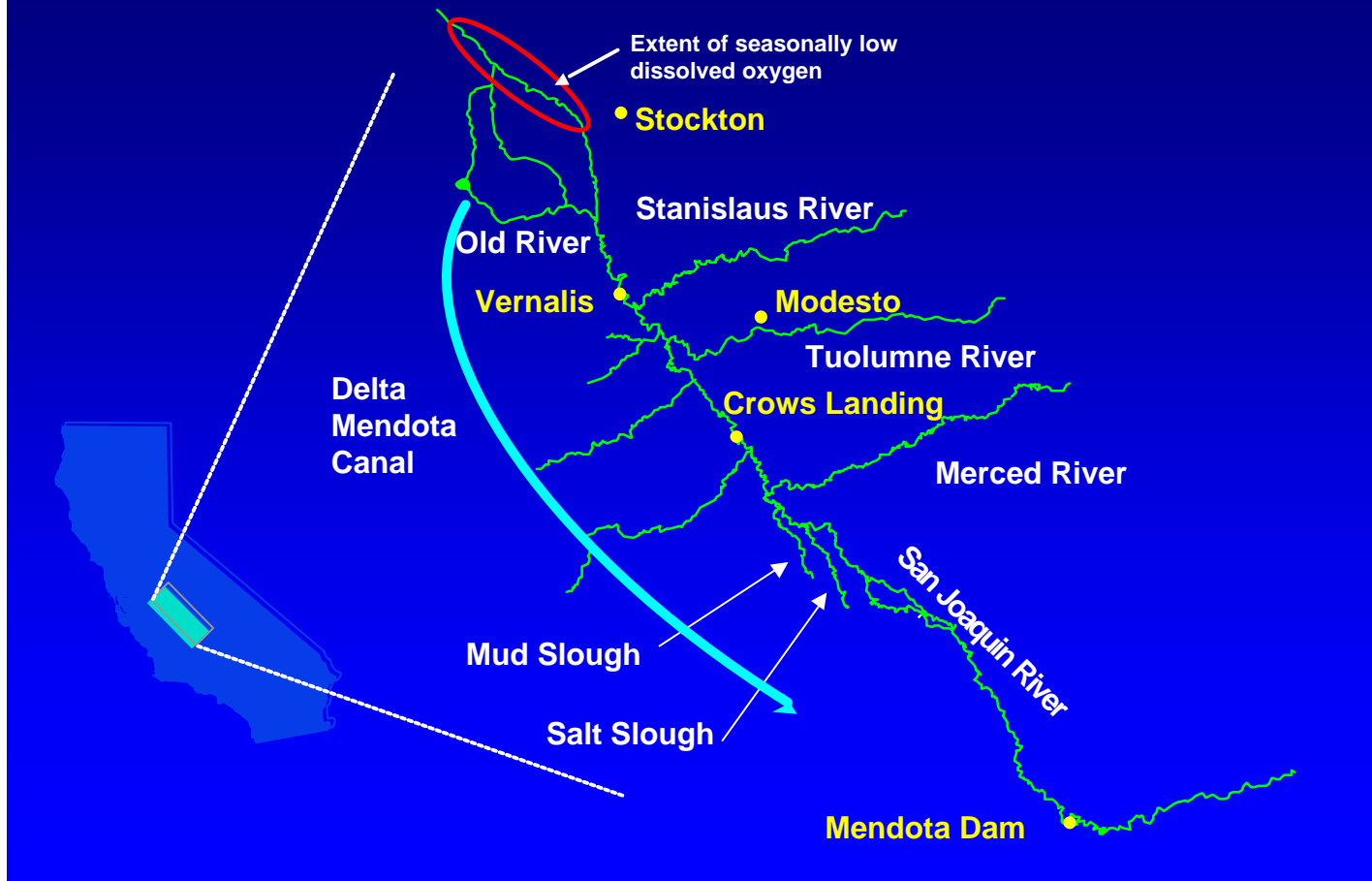 MOS: margin of safety

Components of TMDLs

- TMDL Description (Problem Statement)
- Numeric Targets (will often be new water quality objectives)
- Source Analysis
- Allocations
- Linkage Analysis (relationship between sources, allocations, and targets)
- TMDL Report

- *Implementation Plan*
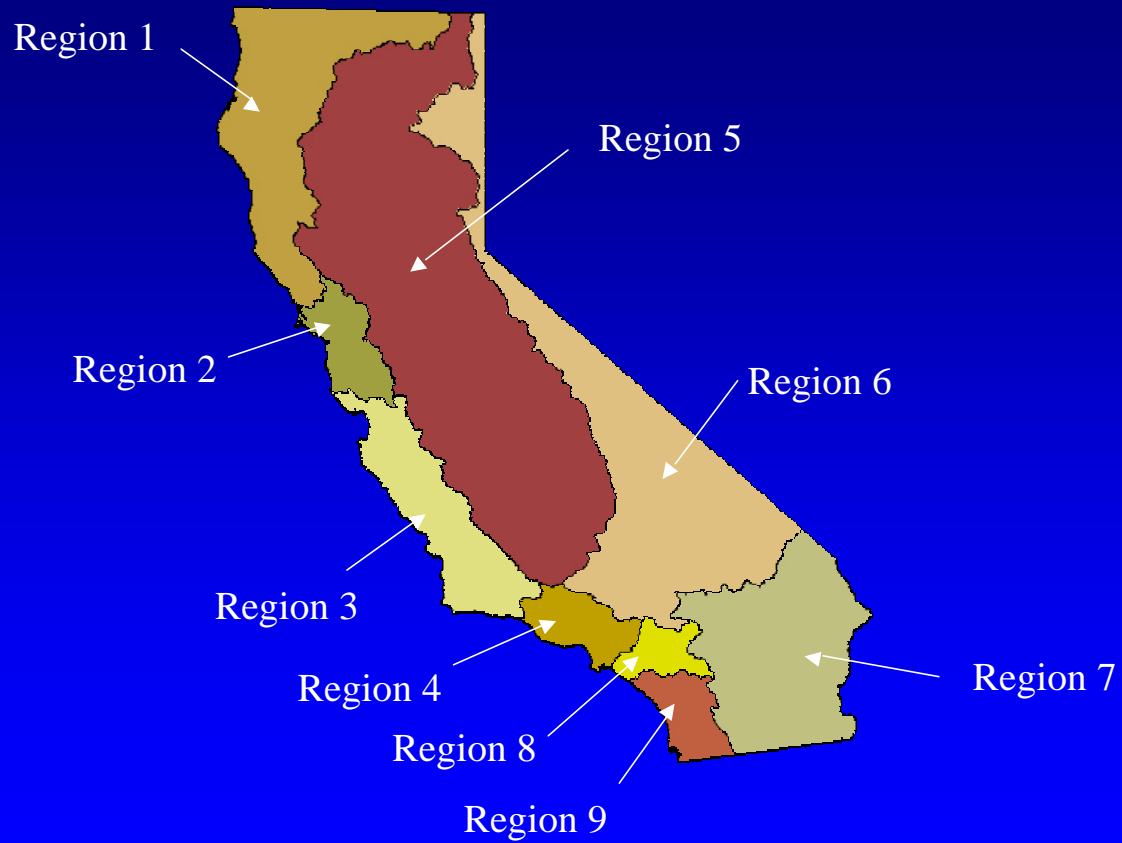
Lower San Joaquin River Basin
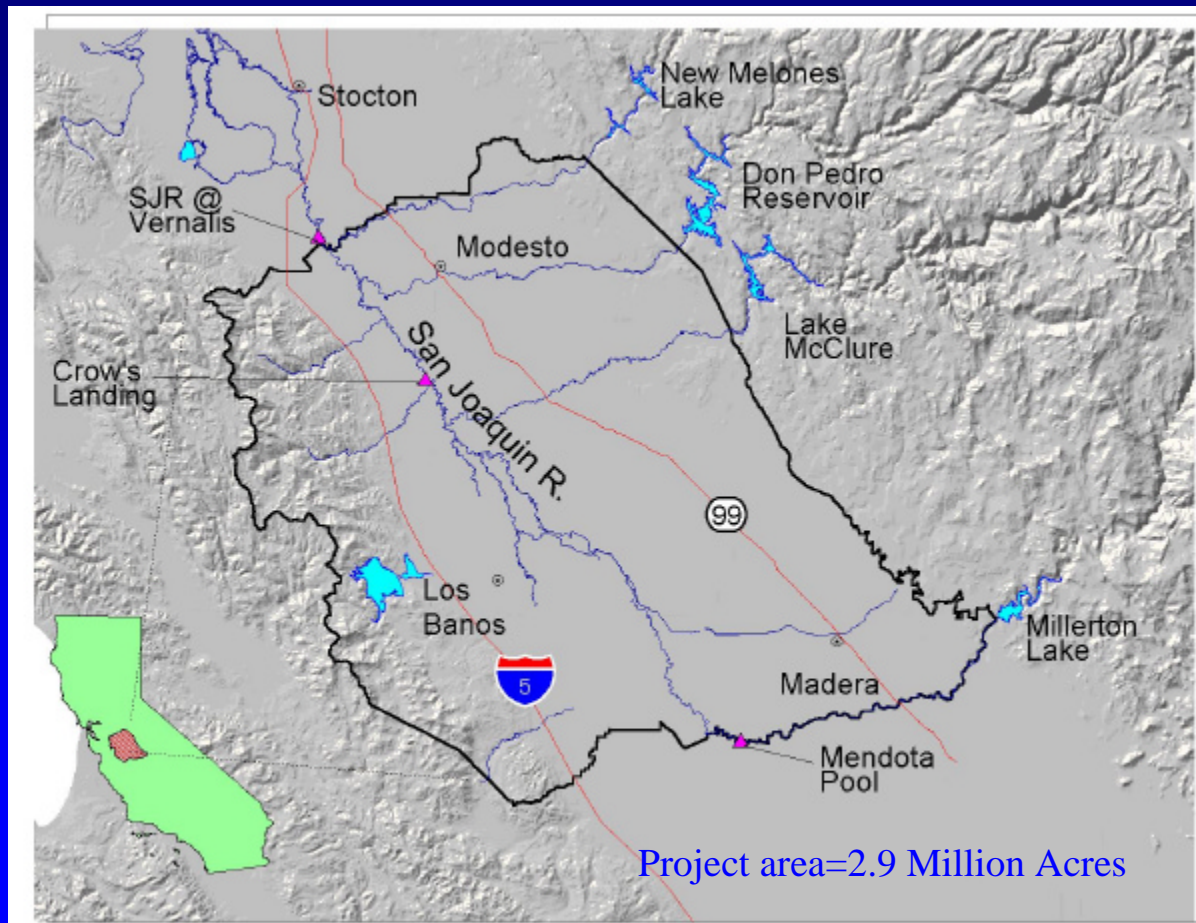
TMDL Timeline

Current Activities

Watershed	June 2001	June 2002	June 2003
San Joaquin River	Selenium Salt & boron	Diazinon & chlorpyrifos	
Delta			Dissolved oxygen Diazinon & chlorpyrifos Mercury
Sacramento River	Copper, zinc, & cadmium	Diazinon	
Clear Lake	Mercury		
Cache Creek		Mercury	

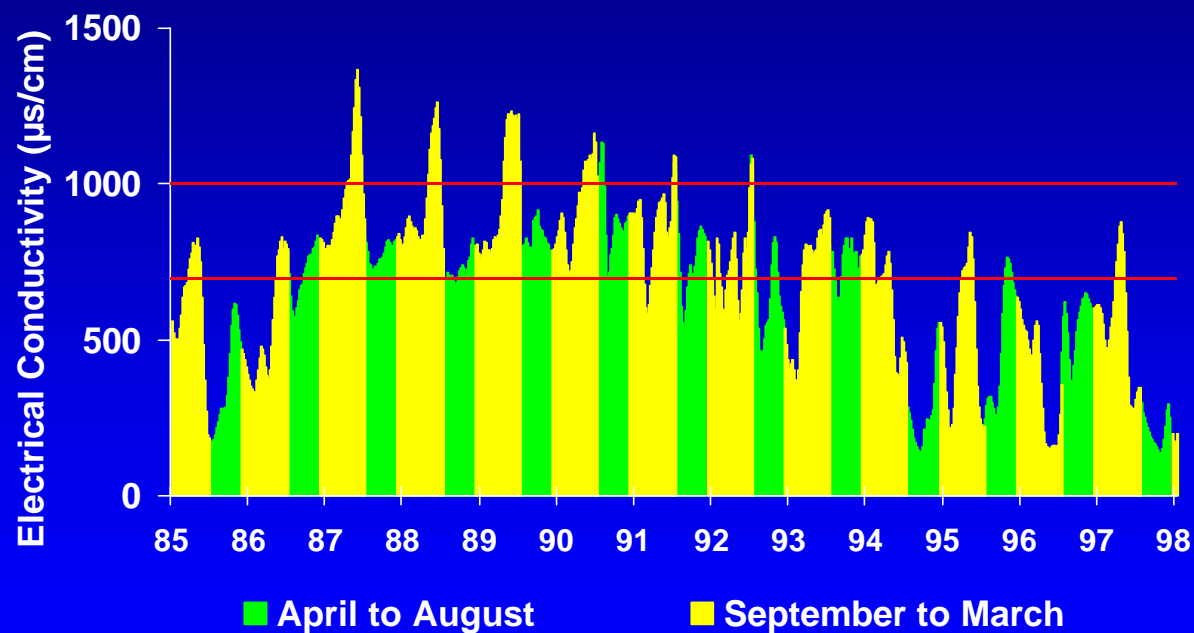# Project Area for Salinity and Boron TMDL

Project area=2.9 Million Acres

TMDL Components

- Problem Statement
- Numeric Targets
- Source Analysis
- Loading Capacity
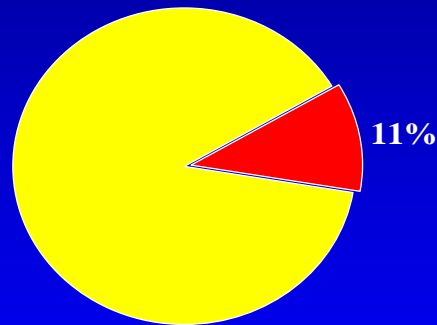- Load Allocations
- Implementation Plan

San Joaquin River near Vernalis
30 Day Running Average Electrical Conductivity
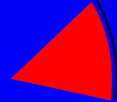
San Joaquin River near Vernalis
Percent of days that 30-day running average electrical conductivity objective has been exceeded from water year 1986 through 1998

11%

49%

September to March
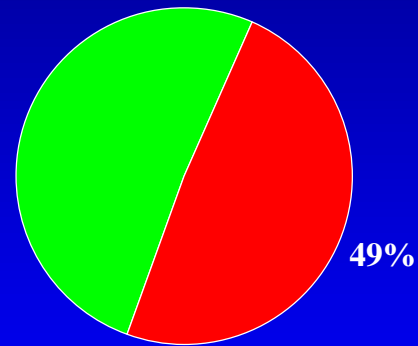
April to August

Percent of Days Objective Exceeded

Salinity and Boron Numeric Targets at Vernalis

	Irrigation Season (April-Sept.)	Non-Irrigation Season (October-March)
Salinity	**700 (µS/cm)**	**1000 (µS/cm)**
Boron	**0.8 (mg/L)**	**1.0 (mg/L)**

TMDL Source Analysis

Objective:

Determine the quantity and location of the sources of salt and boron loading in the watershed

Ensure that all significant sources will be addressed so that load allocations result in achievement of Numeric Targets

Approach:

- Divide the watershed into geographic sub-areas

- Use monitoring data and modeling to determine loading from sub-areas and source types.

Lower San Joaquin River Basin Sub-areas
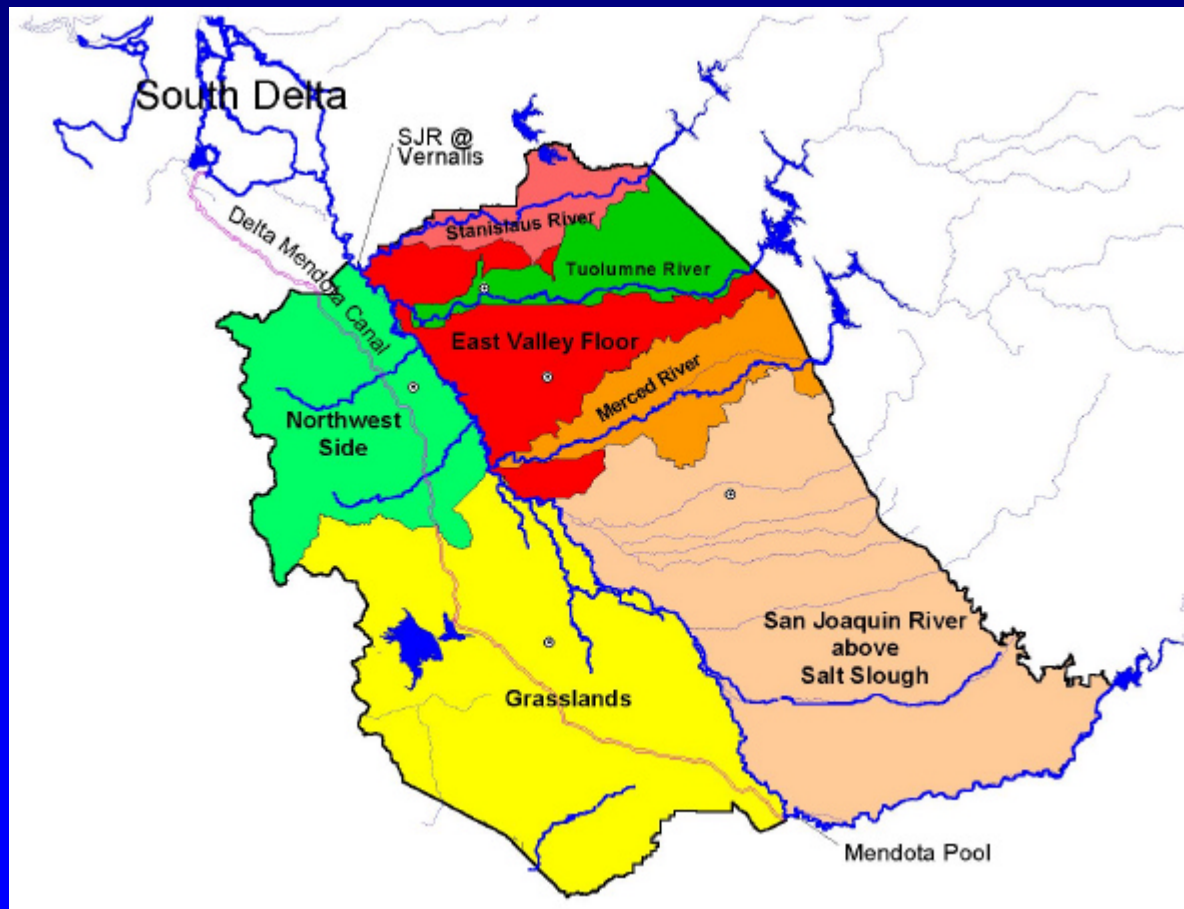
Modification to The LSJR above Salt Slough
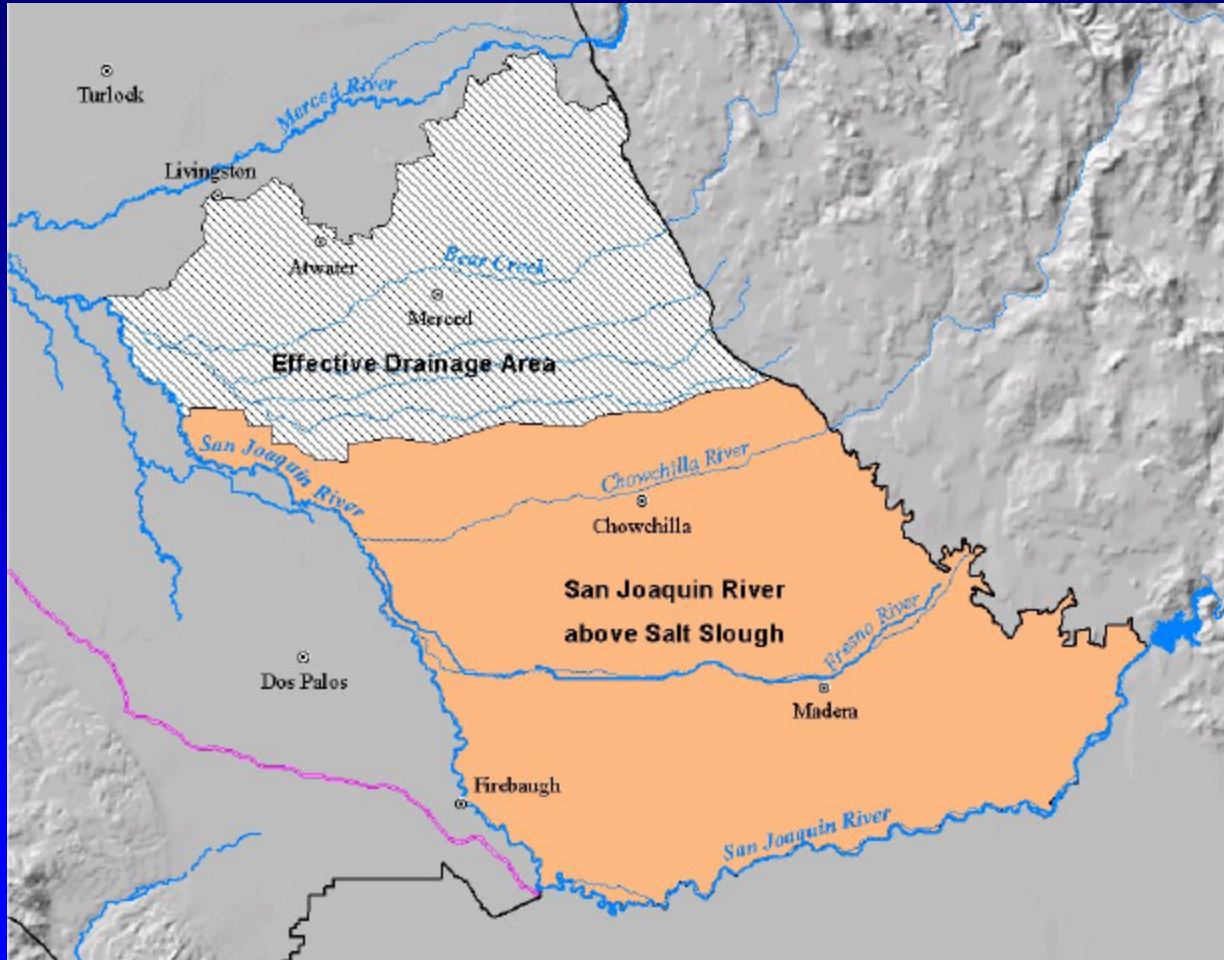
Sources of Salt (by sub-area)

- ■ **Northwest Side***
- ■ **Grassland Watershed**
- ■ **SJR Upstream of Salt Sl.**
- ■ **Merced**
- ■ **Tuolumne**
- ■ **Stanislaus**
- ■ **East Valley Floor****
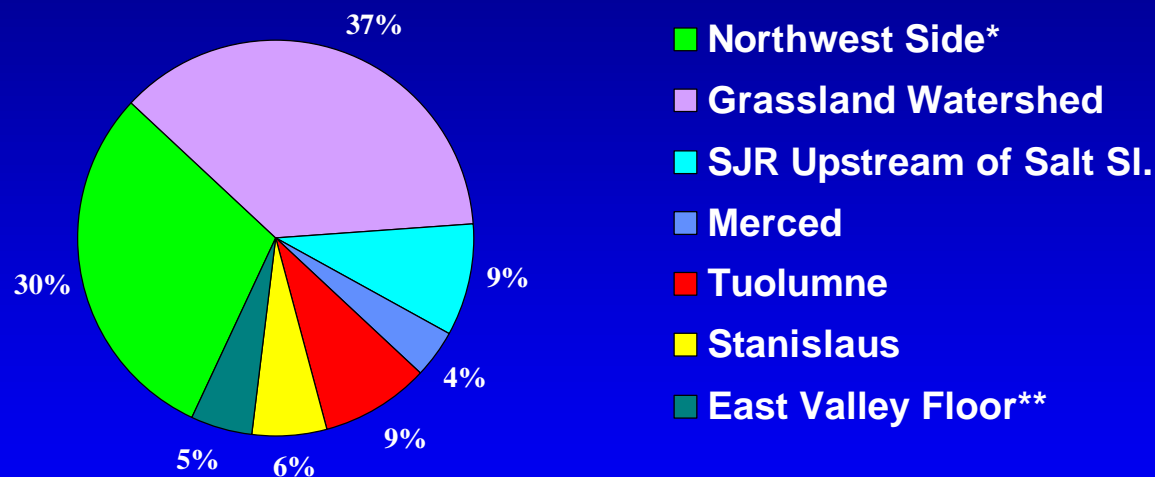
Mean Annual Salt Load to SJR for WY 1977 to 1997: 1.1 million tons

*Northwest Side estimated by difference :Vernalis minus sum of other sources
** East Valley Floor extrapolated from TID 5 data (1985-1996)

Northwest Side Sub-area Load =

Vernalis Load – Σ All Other Sub-area Loads

> Grassland Load
>
> East Valley Floor Load
>
> Merced River Load
>
> Stanislaus River Load
>
> Tuolumne River Load
>
> LSJR abv. Salt Slough Load

Alternative Methods for Estimating Northwest Side Loads

1. Orestimba Creek Extrapolation Method

- Total annual salt load from Orestimba Creek watershed was applied to the entire NWS sub-area

2. Discrete Discharge Method

- Agricultural surface water drainage

- Agricultural tile water drainage

- Ephemeral stream flow from natural runoff

- Waste water treatment discharge

Comparison of calculated salt loads from the Northwest Side

Load calculation method	Average Annual Salt Load (1000 tons/year)	Groundwater Salt Contribution (1000 tons/year)	Total Salt Load (1000 tons/year)
(1) Mass balance approach	310	-8.5 (east side GW)	301.5
(2) Orestimba extrapolation approach	163	138 (west side GW)	301
(3) Discrete discharge approach	130	138 (west side GW)	268

Land Use in the
Lower San Joaquin River Basin
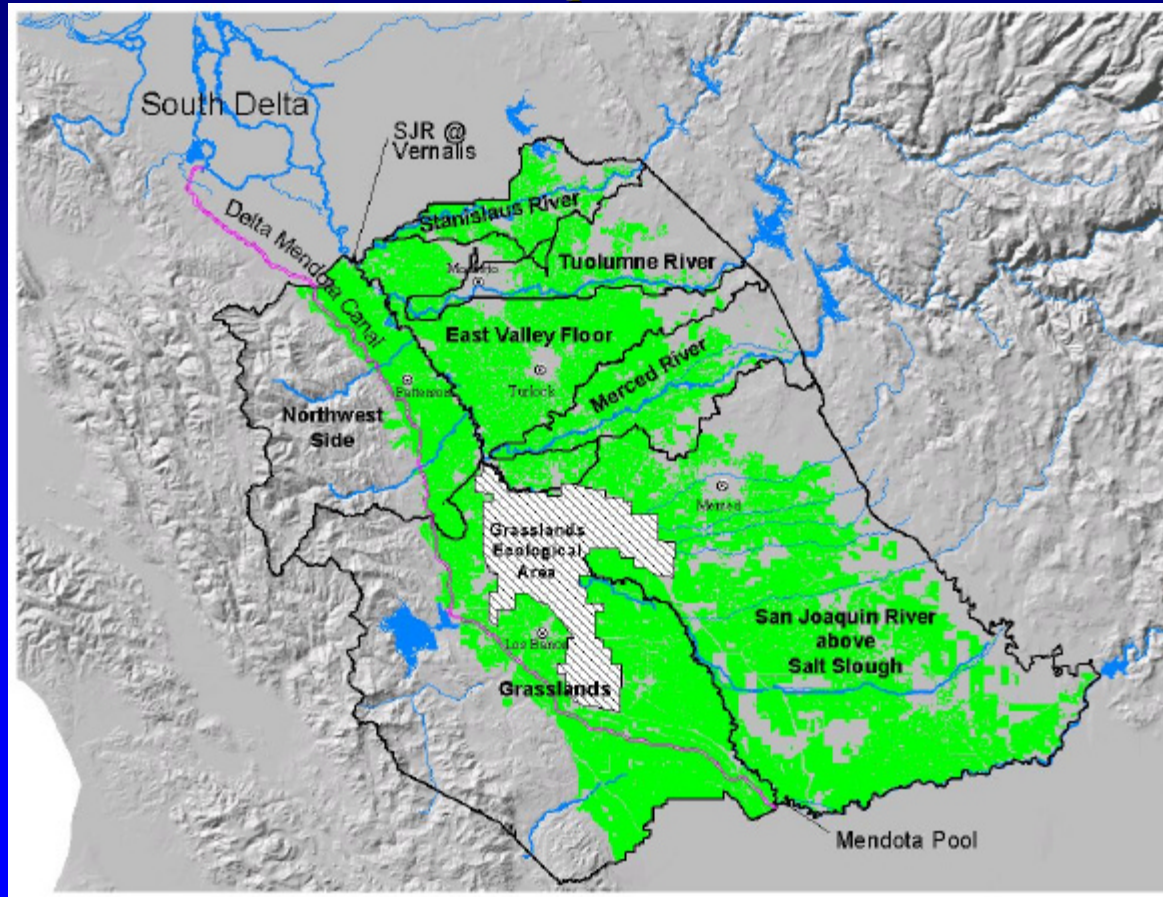
Lower San Joaquin River Basin NPS Land Uses

Sub-area	Agriculture	Managed Wetlands	Total
SJR above Salt Sl.*	149	34	183
Grasslands	331	100	431
North West Side	119	--	119
East Valley Floor	216	--	216
Merced River	94	--	94
Tuolumne River	52	--	52
Stanislaus River	53	--	53

in 1000 acres

* Based on effective drainage area

Lower San Joaquin River Basin Agricultural/Wetland Land Use
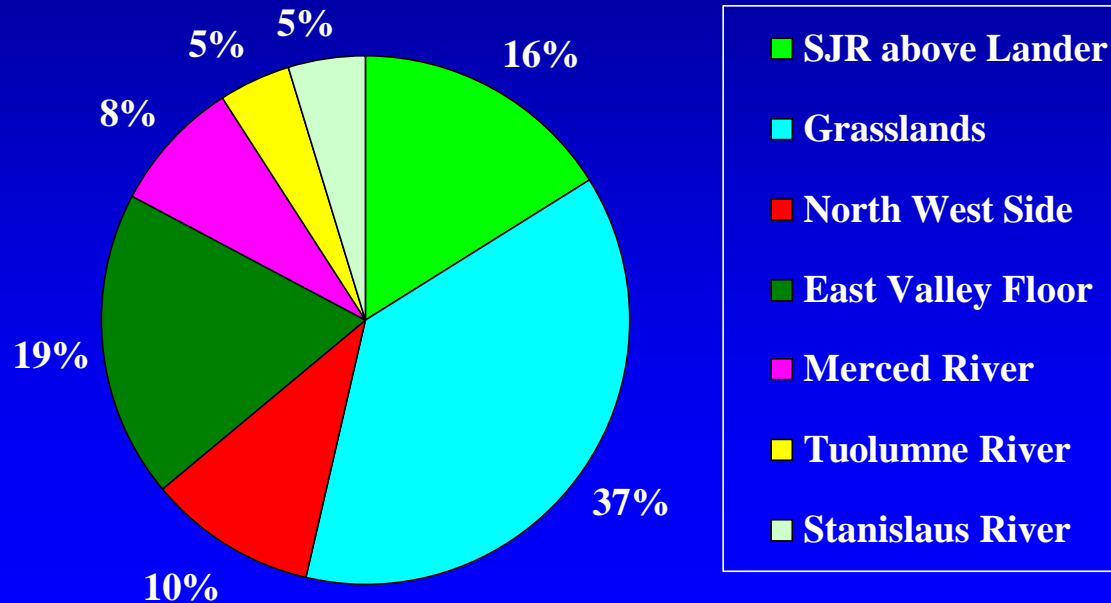
Non Point Source Loading
(Per Acre by Sub-area)

SUB-AREA	NPS (1000 acres)	NPS* Loads (1000 tons/year)	NPS Load (tons/acre/year)
SJR above Salt Sl.	183	22	0.12
Grasslands	431	400	0.93
North West Side	119	306	2.57
East Valley Floor	216	49	0.23
Merced River	94	14	0.15
Tuolumne River	52	30	0.58
Stanislaus River	53	14	0.27

*NPS Load = total sub area load – background load – M&I Load

*(NPS load includes groundwater loads)

Non Point Source Loading
(Per Acre by Sub-area)

SUB-AREA	NPS (1000 acres)	NPS Loads (1000 tons/year)	NPS Load (tons/acre/year)
SJR above Salt Sl.	183	22	0.12
Grasslands	431	400	0.93
North West Side*	**119**	**182**	**1.53**
East Valley Floor	216	49	0.23
Merced River	94	14	0.15
Tuolumne River	52	30	0.58
Stanislaus River	53	14	0.27

* Deep groundwater salt contribution subtracted from North West Side

Non Point Source Loading
(Per Acre by Sub-area)
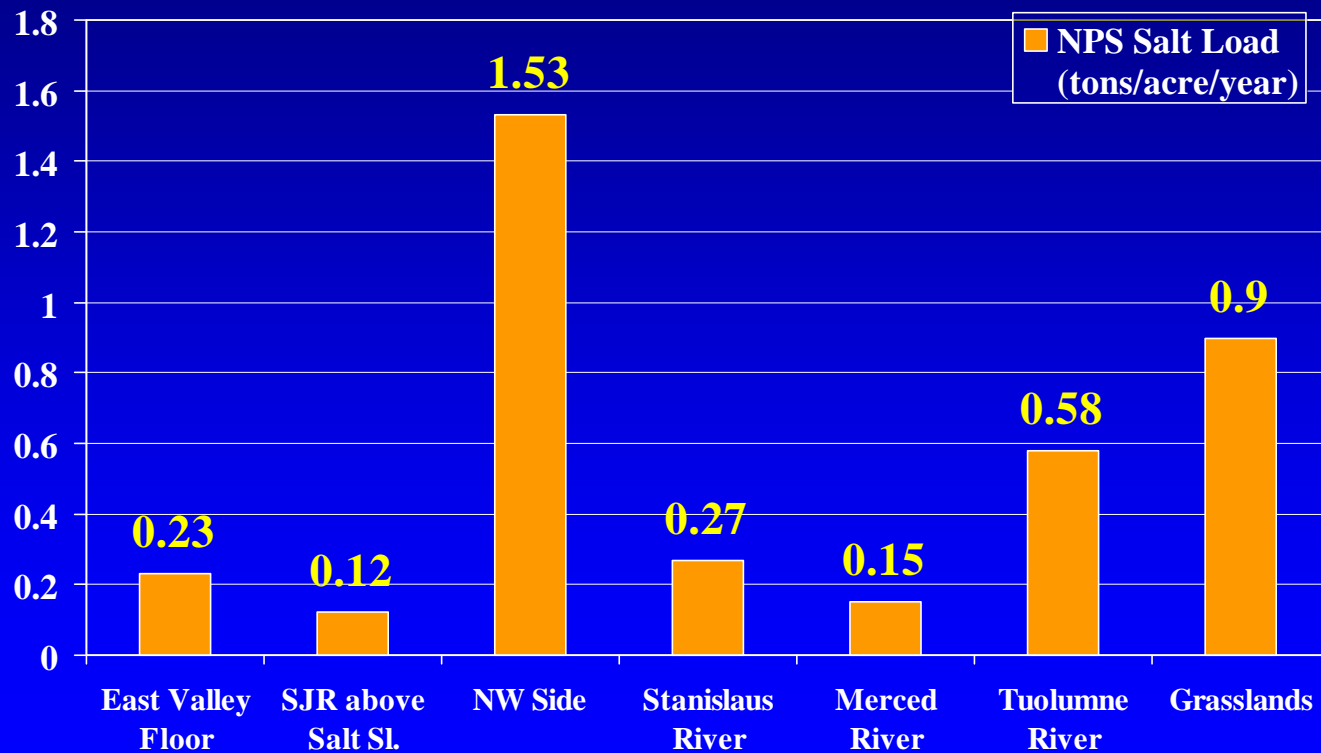
TDS Imported and Discharged from the West Side* of the LSJR
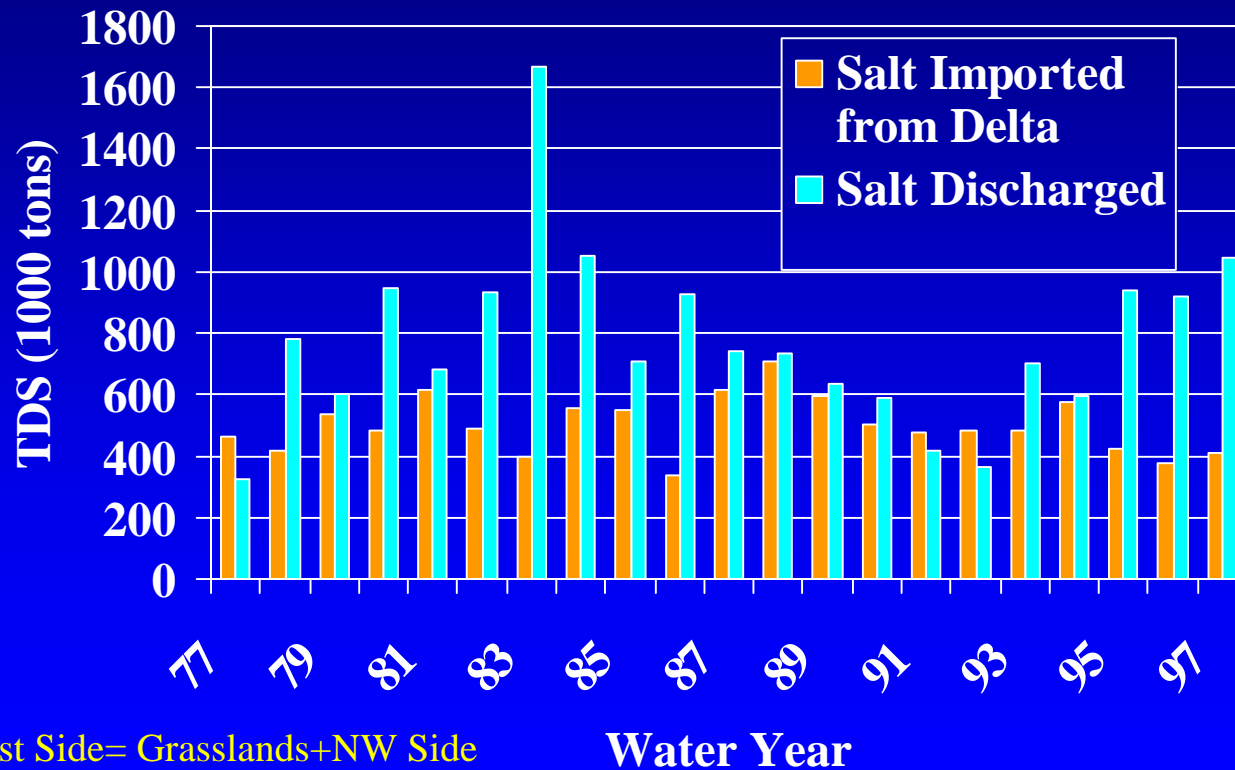
Average Annual TDS Imported and Discharged from LJSR Sub-areas 1977-1997
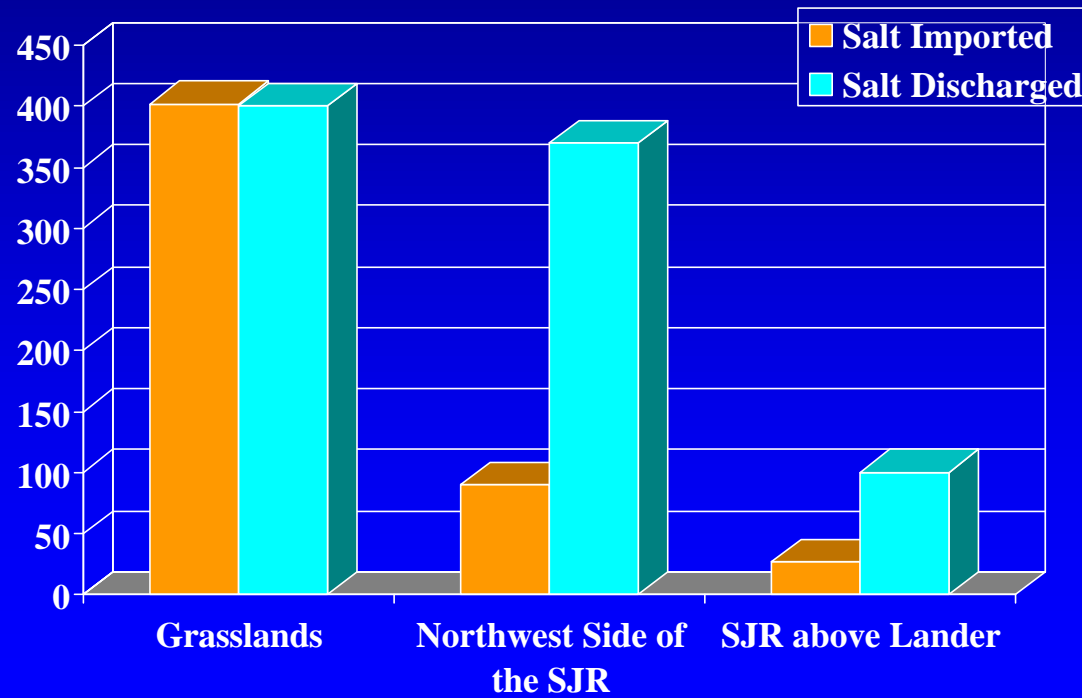
TMDL Loading Capacity

Objective:

- Determine the maximum amount of salt and boron loading that occur while meeting the water quality objectives at Vernalis

Components of Loading Capacity

    1) Design Flow

    2) Supply Water Relaxation

    3) Real Time Relaxation

TMDL Loading Capacity

Developing Design Flows:

- Construct a long-term historic flow record superimposing the current level of water development on past flow regimes

Developing Design Flows:

A 73-year record of flows at Vernalis was compiled from DWRSim model output from CalFed study 771

<u>CalFed study 771 description and modifications</u>

•Best available representation of current LSJR conditions

•Vernalis Adaptive Management Plan (VAMP) flows are included

•Includes releases for water Quality that were mandated by SWRCB Decision 1641

TMDL Loading Capacity

Developing Design Flows:

•Sort flows by month and water-year type

12 months * 5 water year types =

60 month/water year type groupings

TMDL Loading Capacity

Developing design Loads:

- Identify the critical low flow for each month water-year type grouping

- TMML (Loading Capacity) = WQ objective * design Flow

Determining Available Loads:

The TMML must consider ambient loading and a
Margin of Safety

$$TMML = \Sigma\,LA + \Sigma WLA + BG\ loads + GW\ Loads + MOS$$

Load Allocations are dependant on background loads
and groundwater loads

$$\Sigma\,LA + \Sigma WLA = TMML\text{-}(BG\ loads + GW\ Loads + MOS)$$

Base Salt Load Allocations (available Load)

Year Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
W	103	207	281	196	211	41	8	34	108	231	107	90	1,616
AN	110	207	161	198	165	--	--	16	107	137	87	82	1,269
BN	60	64	84	134	101	--	--	4	92	98	84	77	799
D	74	102	70	77	61	--	--	--	62	76	68	71	662
C	50	46	38	19	--	--	--	--	48	73	64	61	399

(pounds of salt per acre)

Monthly Base Load Allocations
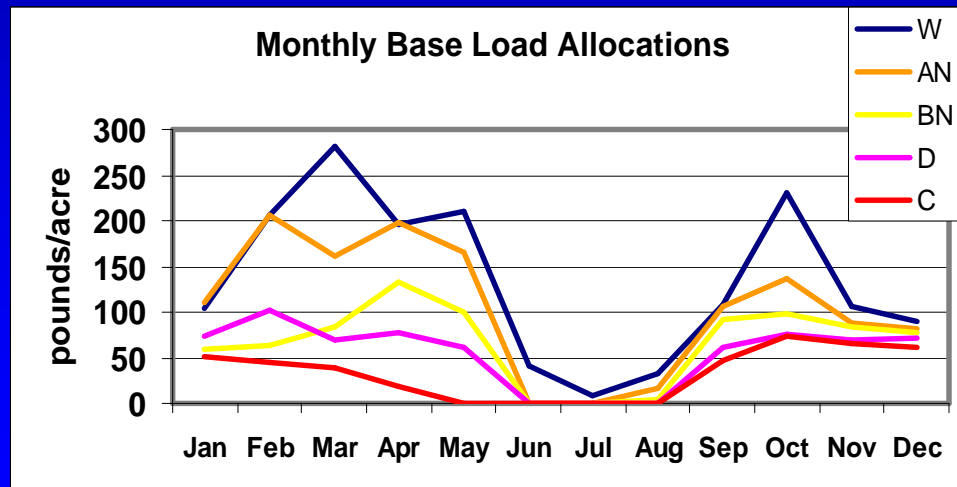
Historical Salt Loading compared to Base TMDL

Historical Salt Loading compared to Base TMDL
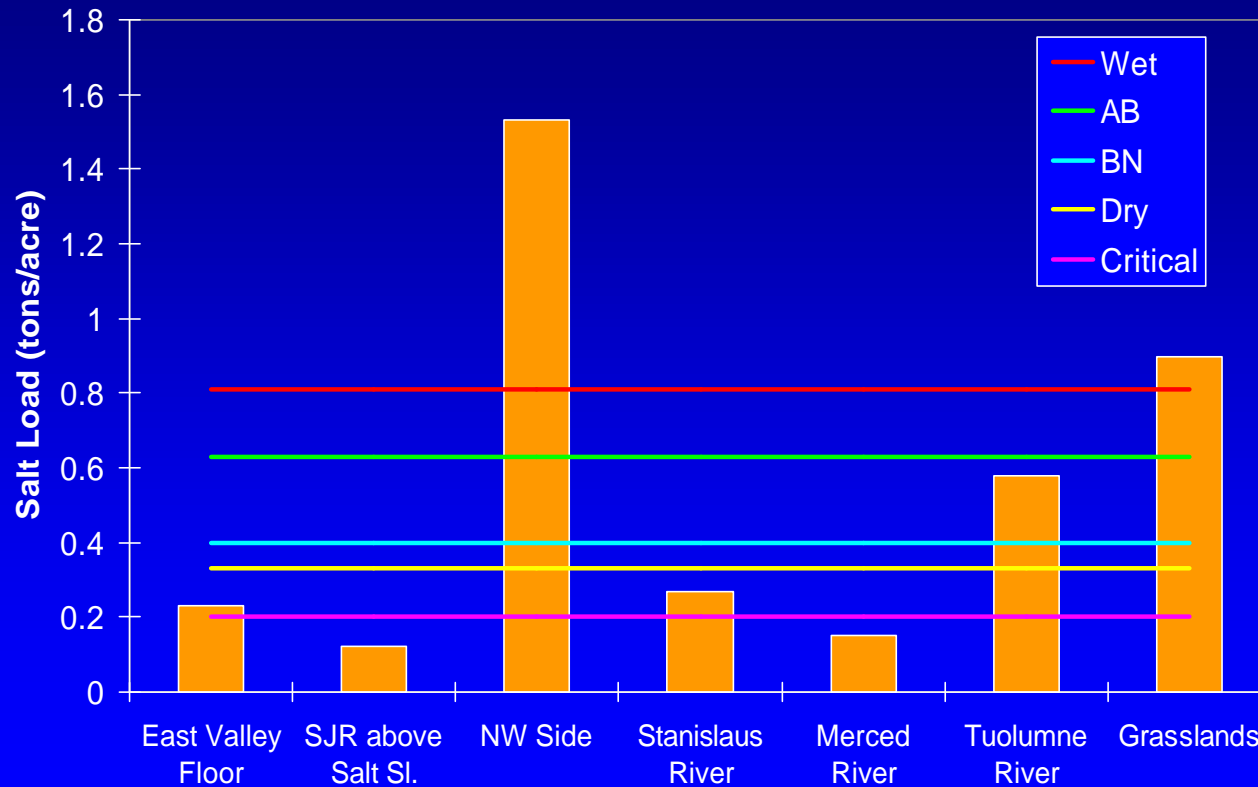
LSJR Above Salt Slough Sub-area Base Load Allocations
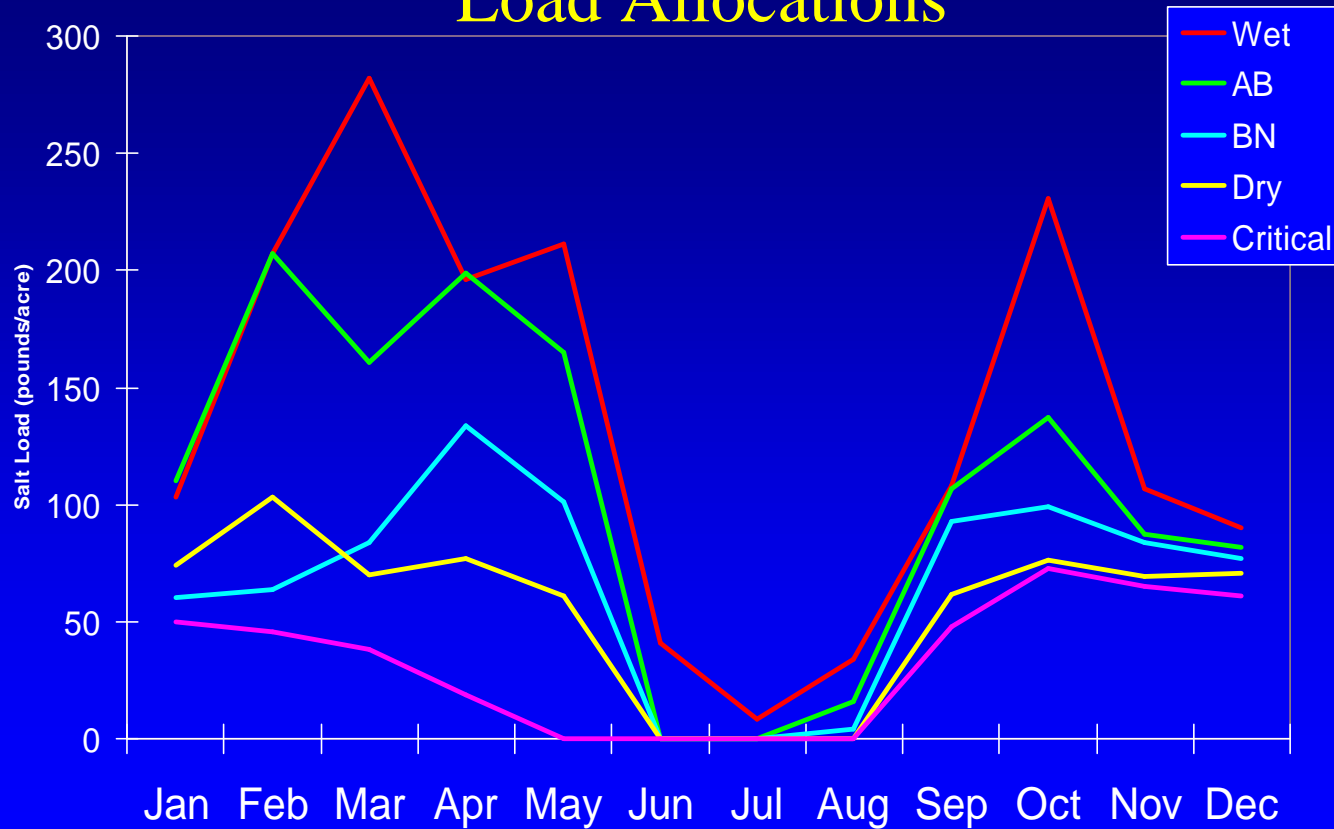
LSJR Above Salt Slough Sub-area Base Load Allocations
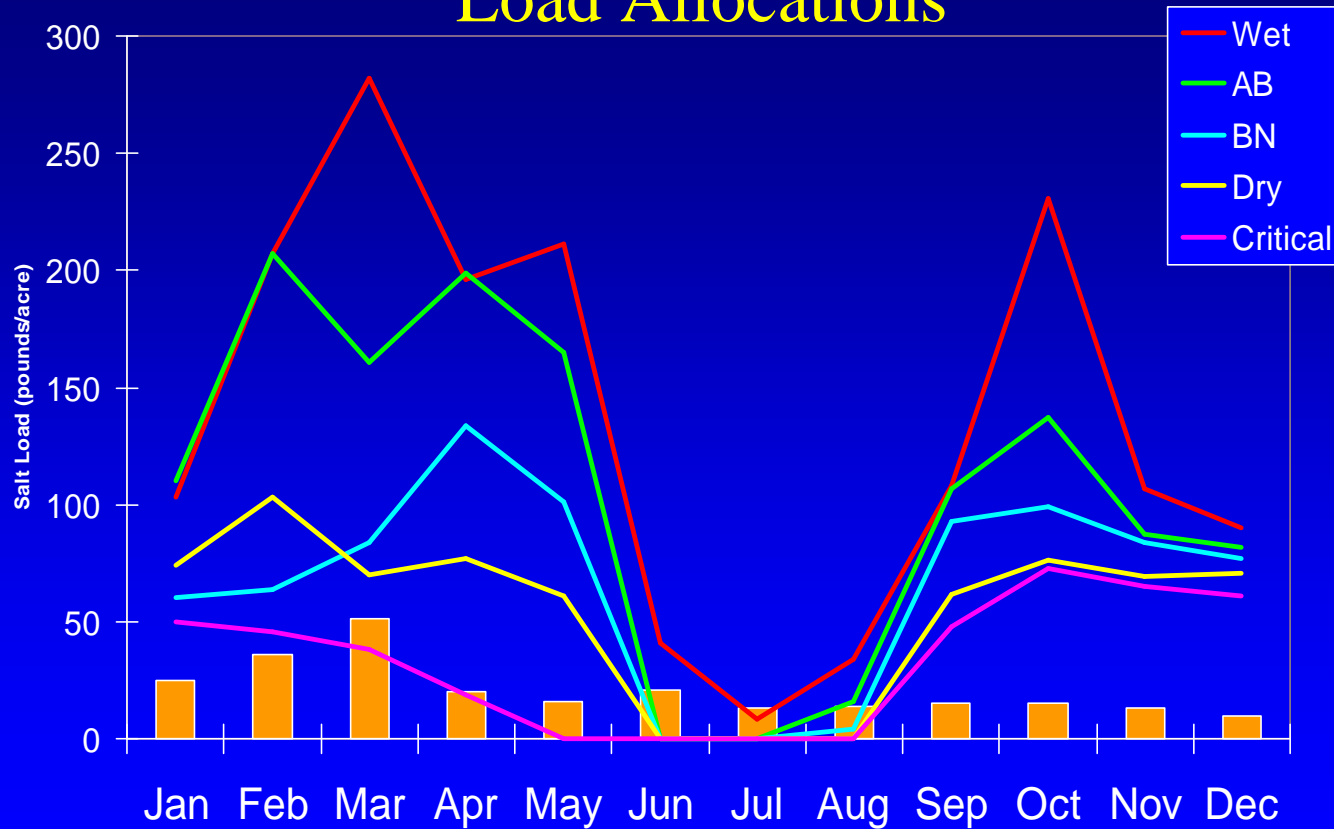
Load Allocations

Load Allocations

- Special Considerations
  - Phased Approach
  - Central Valley Project Impacts
  - Need for Salt Balance
- Load Allocation Methodology
  - Base Load Allocation
  - Import Water Relaxation & CVP Load Allocation
  - Real-time Relaxation

Objective

- The objective is to identify and use a method that will fairly allocate the available loading capacity between various sources throughout the basin

Approach

- The approach taken starts with an evenly distributed base load allocation upon which various additional load allocations are provided to account for several important considerations

Considerations

- Phased Approach
- Central Valley Project Impacts
- Need for Salt Balance

Phased Approach

- Required when a TMDL involves both point and nonpoint sources and the point source waste load allocation is based on a load allocation for which nonpoint source controls need to be implemented

- Preferable because it allows for revision of waste load allocations and load allocations in response to changing hydrologic conditions and availability of additional data and new water quality objectives

Central Valley Project Impacts

- Decreased SJR flows resulting from the diversion of SJR water at Friant Dam to agricultural areas outside of the SJR Basin
- Increased salt load imports to the basin associated with the replacement of SJR water with imports from the Sacramento and San Joaquin River Delta

Central Valley Project Impacts
TMDL Implications

- Responsibility for meeting TMDL load limits must extend beyond usual point and non-point source discharges

- Load limits and allocations must be considered for other responsible parties

- SWRCB in Water Right Decision 1641, recognized that the United States Bureau of Reclamation's actions have reduced water quality of the SJR at Vernalis

Central Valley Project Impacts
SWRCB D-1641

- The SWRCB Order in Decision 1641, adopted 29 December 1999, amended the CVP permits under which the USBR delivers water to the San Joaquin Basin to require that the USBR meet the 1995 Bay Delta Plan Salinity objectives at Vernalis

- The USBR has wide latitude in developing a program to achieve this result

Need for Salt Balance

- Salt and boron are naturally occurring elements that are mobilized whenever water is applied to soils (precipitation and applied irrigation water)
- Concentrations of salt and boron also increase as a result of evapotranspiration
- Historically more salt has been imported to basin that has been exported

Need for Salt Balance
TMDL Implementation

- Typically, fixed TMDL load limits are established to meet water quality objectives during low flow conditions

- Recognizing need to maintain a salt balance in the basin, there is a need in salt and boron TMDL to maximize salt exports while still meeting water quality objectives

Special Considerations
Conclusions

- TMDL load limits must be established that recognizes changing conditions in basin:

- Allowance must be made for dischargers that receive impaired water

- Load limits must be established for entities that are responsible for salt imports

- Relaxation in load limits is needed to take advantage of periods with assimilative capacity greater than those afforded by low flow conditions

Challenge:

How can these special considerations
be incorporated in the TMDL?

Load Allocation Methodology

- Base Load Allocation Method
- Import Water Relaxation
- CVP Load Allocation
- Real-time Relaxation

Base Load Allocation

- Uses expected low flow (worst-case) conditions
- Background loads subtracted from total loading capacity
  - Sierra Nevada supply water
  - Groundwater
- Waste load allocation assigned to point sources initially set at current loading rates
- Remaining assimilative capacity is evenly distributed to non-point sources in entire basin
- Emphasis on method, rather than fixed numbers

Base Salt Load Allocations all Sub-areas

Year Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
W	103	207	281	196	211	41	8	34	108	231	107	90	1,616
AN	110	207	161	198	165	--	--	16	107	137	87	82	1,269
BN	60	64	84	134	101	--	--	4	92	98	84	77	799
D	74	102	70	77	61	--	--	--	62	76	68	71	662
C	50	46	38	19	--	--	--	--	48	73	64	61	399

(pounds of salt per acre)

Annual Load Allocations

Year Type	Annual Load Allocation (pounds per acre)		
	Base Load		
W	1,616		
AN	1,269		
BN	799		
D	601		
C	399		

(pounds of salt per acre)

Import Water Relaxation
(Central Valley Project Imports)

- Subareas with impaired (high salt) water supply receive additional load allocation
- This "import water relaxation" is set at 50 percent of mean salt load imported to the subarea during low flow conditions
  - Assumption: 30 percent return flow with some added salt to account for evapo-concentration and leaching of salt from prior years
- Problem: additional load allocation results in violation of water quality objectives

Import Water Relaxation
(San Joaquin River Diversions)

- Subareas that divert high salt San Joaquin River water supply receive additional load allocation

- This "SJR diversion relaxation" is set at supply water quality (with TMDL in place) minus base load (Sierra Nevada water quality)

- Problem: additional load allocation results in violation of water quality objectives

Grassland Subarea
Import Water Relaxation

Year Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
W	11	32	78	98	104	134	124	133	101	96	58	21	991
AN	8	27	54	122	145	154	119	138	131	97	44	16	1,056
BN	8	31	74	143	170	182	165	165	175	140	69	25	1,346
D	13	36	83	126	119	127	127	131	146	127	68	28	1,128
C	17	46	89	115	136	173	169	165	142	147	69	30	1,298

(pounds of salt per acre)

North West Side Subarea
Import Water Relaxation

Year Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
W	0	3	0	32	33	45	59	57	23	22	12	0	286
AN	0	0	0	37	41	48	51	55	26	19	7	0	282
BN	0	0	0	41	61	72	91	69	50	40	17	0	441
D	0	0	0	4	6	6	10	10	4	4	0	0	45
C	0	0	0	0	0	0	0	0	0	0	0	0	0

(pounds of salt per acre)

North West Side Subarea
SJR Diversion Relaxation

Year Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
W	0	21	322	346	498	565	416	401	242	36	0	0	2,846
AN	0	28	163	379	572	420	405	316	245	40	0	0	2,569
BN	0	19	145	364	515	473	450	283	264	53	0	0	2,566
D	0	21	131	256	408	609	531	227	197	48	0	0	2,426
C	0	21	93	201	260	438	370	214	135	45	0	0	1,777

(pounds of salt per acre)

Annual Load Allocations

Year Type	Annual Load Allocation (pounds per acre)		
	Base Load	Import / SJR diversion relaxation	
		Grassland	North West Side
W	1,616	991	3,133
AN	1,269	1,056	2,850
BN	799	1,346	3,007
D	601	1,128	2,471
C	399	1,298	1,777

(pounds of salt per acre)

Annual Load Allocations

Year Type	Annual Load Allocation (pounds per acre)		
	Base Load	Base + Supply water relaxation	
		Grassland	North West Side
W	1,616	2,607	4,749
AN	1,269	2,326	4,120
BN	799	2,145	3,805
D	601	1,729	3,132
C	399	1,697	2,176

Subarea Load Allocations
(Below Normal Water Year)

Sub-area	Total acreage	Base Load	Load Allocations (1000 tons)		Total
			Supply Water Relaxation		
			Import	SJR Diversion	
SJR above Salt Slough	183,259	73			73
Grassland	430,722	172	290		462
North West Side	118,649	47	26	152	225
East Valley Floor	216,131	86			86
Merced River	94,180	38			38
Tuolumne River	52,111	21			21
Stanislaus River	52,715	21			21
Totals	1,147,767	458			926

Import Water and SJR Diversion Relaxation

- Problem: addition of these salt load allocations will result in violation of water quality objectives

- Solution: impose load limits on supply water

CVP Load Allocation

- The USBR is responsible for salt load in Central Valley Project (CVP) water delivered to the TMDL project area that is in excess of a base load for equivalent volume of Sierra Nevada quality water

- This load responsibility offsets additional allocation provided to subareas that receive CVP water

CVP Actual Loads

Year Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
W	5	14	33	46	49	63	60	64	46	44	26	9	461
AN	3	12	23	57	67	72	57	66	60	44	20	7	488
BN	3	13	32	66	80	87	82	79	81	65	32	11	632
D	5	15	36	55	52	55	56	58	63	55	29	12	491
C	7	20	38	49	59	75	73	71	61	63	30	13	559

(1,000 tons of salt)

CVP Load Allocation

CVP Base Load Allocation*													
Year Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
W	1	2	6	10	12	14	14	13	10	10	4	2	96
AN	1	2	5	9	11	12	12	12	9	9	4	2	88
BN	1	2	4	9	13	15	15	13	11	11	5	2	99
D	1	2	4	7	8	9	9	9	7	7	3	1	66
C	1	2	4	6	7	8	8	7	6	6	3	1	59

(1,000 tons of salt)

* assumes base water quality of 52 mg/L

CVP Excess Load

CVP Excess Load													
Year Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
W	4	12	28	36	37	49	47	52	36	34	22	7	365
AN	2	10	19	48	57	60	45	54	50	35	16	5	400
BN	3	11	28	58	67	72	67	66	71	54	27	9	533
D	4	13	32	48	44	46	47	49	56	48	26	11	425
C	7	18	34	44	51	67	65	64	55	57	27	12	500

(1,000 tons of salt)

* assumes base water quality of 52 mg/L

Subarea Load Allocations
(Below Normal Water Year)

| Sub-area	Total acreage	Base Load	Supply Water Relaxation Import	SJR Diversion	Total
SJR above Salt Slough	183,259	73			73
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Stanislaus River	52,715	21			21
Totals	1,147,767	458			926
DMC Load Allocation		99			
DMC Excess Load		533			

Load Allocations (1000 tons)

Real-time Relaxation

- Base loads plus import water relaxation may still be too restrictive to allow for long-term compliance with water quality objectives since salt imports will continue to exceed salt exports

- Real time relaxation provides for additional load allocations

Real-time Relaxation

- Real time relaxation may only be employed if physical and organizational infrastructure is put in place to effectively manage discharges in the basin

- An additional margin of safety will have to be used to assure compliance with water quality objectives

Base Salt Load Allocations (available Load)
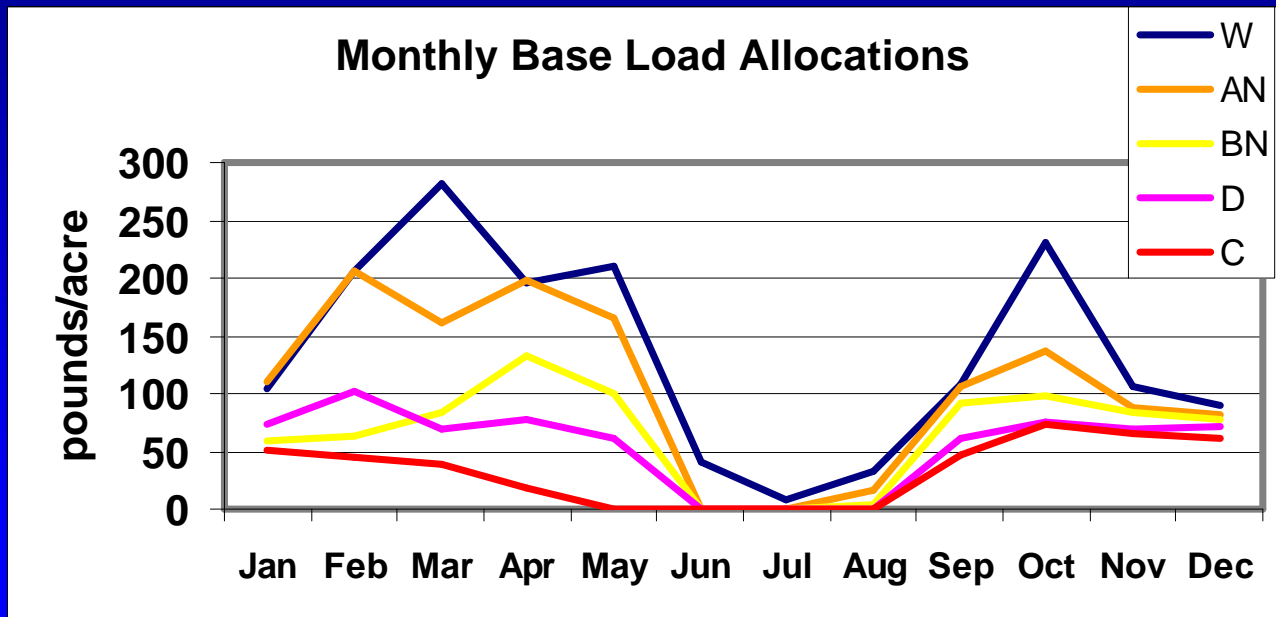
Historical Salt Loading compared to Base TMDL
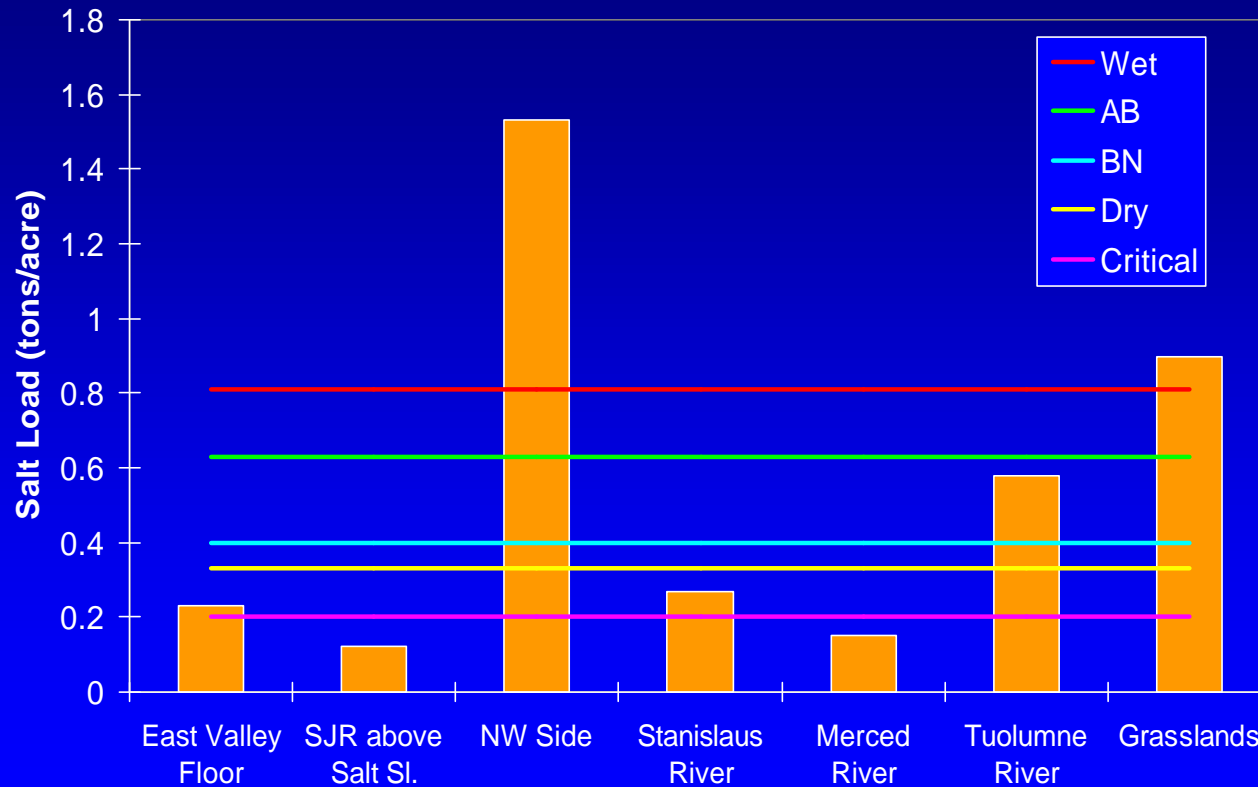
Conclusions

- Framework for a salt and boron load allocation method has been presented
- Base load allocations evenly distributed throughout basin
- Framework accounts for degraded supply water quality
- Responsibility for meeting salt load limts is shared by dischargers and the USBR

Conclusions

- Emphasis is on method, rather than fixed numbers, to account for changing flow and water quality conditions in SJR Basin

More Information

- Salt and Boron Basin Plan Amendment:

  http://www.swrcb.ca.gov/~rwqcb5/salt_boron/documents.html

- TMDL Program:

  http://www.swrcb.ca.gov/~rwqcb5/TMDL/index.htm